VITICULTURE AND ATYPICAL AGEING

Hans R. Schultz, Otmar Löhnertz, Bärbel Hünnecke, Albert Linsenmeier
The Geisenheim Research Institute, von Lade Str. 1, D-65366 Geisenheim, Germany

Since atypical aging (ATA) was first been detected in Germany in 1988, many solutions to this problem have been proposed. However, we still lack the final answer to what is causing ATA and why it appears in some wines and why not in others. There is a unanimous opinion that ATA is coming from the vineyard and that enological measures may at best delay its appearance but never solve the problem entirely. ATA has been attributed to the formation of 2-aminoacetophenone (2AAP) (Rapp et al. 1993), whose presence at a concentration of about 0.7-1.0 µg/L seems to be the perception threshold (Rapp and Versini 1995). The attributes of the wines are often accompanied by perceived bitterness. Despite the fact that ATA results from a physiological problem of the vine, we are still unable to point out the processes (chain of events) which ultimately cause the problem. There have been indications that lack of nitrogen, lack of water, early harvest, competition through cover crops and over-cropping can cause ATA, yet for almost all of the above factors exceptions to the rule exist.

Soil and nitrogen management

Lack of nitrogen was first detected as one of the key factors in the formation of ATA. The problem can be aggravated by shortage of water, since water is the transport medium of N, and without water even heavy doses of N will have no effect. Low nitrogen levels in the soil will reduce the levels of yeast assimilable nitrogen in the fruit causing stuck fermentations and contributing to off-flavor formation such as ATA and others.

Most of the initial growth of grapevines after bud break is “sponsored” by N- and carbohydrate reserves in the woody plant parts (Löhnertz 1988) and this reserve pool needs to be replenished towards the end of the season. Continuous lack of N will not only affect this years crop but also reduce the allocation of N to storage compartments. In these cases, even large amounts of N-containing fertilizers will not cure the problem immediately (if at all) since the plants will first replenish their reserves.

Cover crops compete for N and water and can aggravate the problem. In vineyard sites with shallow soils and soils with low water holding capacity, it is recommended to disturb cover crops established over the winter period by mulching or even ploughing in alternate rows around bud break. The advantage is, that at this time of the season there is still sufficient water in the soil so that mineralization of N from organic matter can proceed. Additionally, this process will take about 2-3 weeks matching the time period when grapevines themselves start taking up N from the soil. The second peak of N uptake around veraison, when most of the N is incorporated into the fruit, is a much larger problem in terms of management. In most years, dry conditions prevail during that period (August), thus added N or mulching of the cover crop will not have an effect. Additionally, adding N during this period is risky, since precipitation in September may lead to excessive N availability and fruit growth and may cause problems with botrytis infection. For these reasons foliar applications with N-containing fertilizers may overcome the problem, yet the optimum composition of these fertilizers in order to be taken up by the plant is still a research topic. In some cases one can reduce the occurrence of 2AAP (Hünnecke et al. 2001), yet the sensory impact is less clear. In a long-tem trial on N-fertilization with Riesling, there was no apparent relationship between AAP formation and N-concentration in the juice (Linsenmeier unpublished) adding more facets to the mystery.

Even when the amino acid concentration is high in the juice, ATA may develop. The 1996 vintage has been an example for this, with very high amino acid concentrations and a very high incidence of ATA.

Irrigation may contribute to avoid ATA. This may or may not be related to improved N-uptake since it was also demonstrated, that the concentration of micro-elements, such as zinc

and manganese, which are important co-enzymes for yeast metabolism, can be substantially increased by irrigation (Werwitzke 2002 unpublished). It is disturbing, however, that Riesling wines from irrigation trials have been judged consistently more bitter than those from non-irrigated vines, where bitterness is often a perceived co-factor of ATA.

Planting density can greatly influence N-uptake and also the sensory perception of fruitiness in Riesling. In high density plantings, roots are forced to grow into deeper soil layers resulting in higher acquisition rates of water and N during periods of stress and substantially increasing amino acid concentrations in juice and wines. In fact doubling planting density in a vineyard with 100% cover crop increased amino acid concentration sufficiently to remain above the 1000-1300mg/l threshold frequently cited as being necessary for “normal” fermentations (Rapp and Versini1996).

Rootstock choice may be part of a viticulturist’s strategy against ATA, yet at present there are no data available on this subject.

It was speculated, that leaf removal from the fruiting zone may decrease N-content in the fruit sufficiently to cause fermentation problems (Betamini and Malossini 1998). It can be calculated that the N contained in the leaves which are removed from the fruiting zone of Riesling vines can fully account for the difference in amino acid N between leaf removal and control treatments raising the question whether this canopy management tool may actually aggravate potential ATA problems (Schultz 1999). However, recent results have not indicated any effect of leaf removal on 2AAP (Hoenicke et al. 2001).

High yields have often been implicated in the formation of ATA (Schwab et al. 1996 and others), yet again there are exceptions to the rule which necessitate a re-evaluation of the causal relationship between various vineyard factors and the formation of ATA. Minimal pruning vines for example have usually much larger crop loads than pruned vines. Despite these yields of 25-30 tons/ha as compared to 10-12 tons/ha of the pruned vines, no ATA has been found in MP Riesling wines not even in “ATA” years such as 1999, whereas the controls start showing signs of ATA! This tendency has been confirmed with other varieties in other German wine regions,

Early harvest dates seem to be a key elicitor of ATA irrespective of the variety. There is a clear correlation between N in the fruit and delaying the harvest date irrespective of the sugar concentration (Fig. 1). Despite the increased danger of botrytis rot and other diseases when delaying the harvest date in cool climate regions, it still seems so far the most reliable and effective viticultural tool against ATA.

Amino-N during fruit ripening 1992 (Riesling)

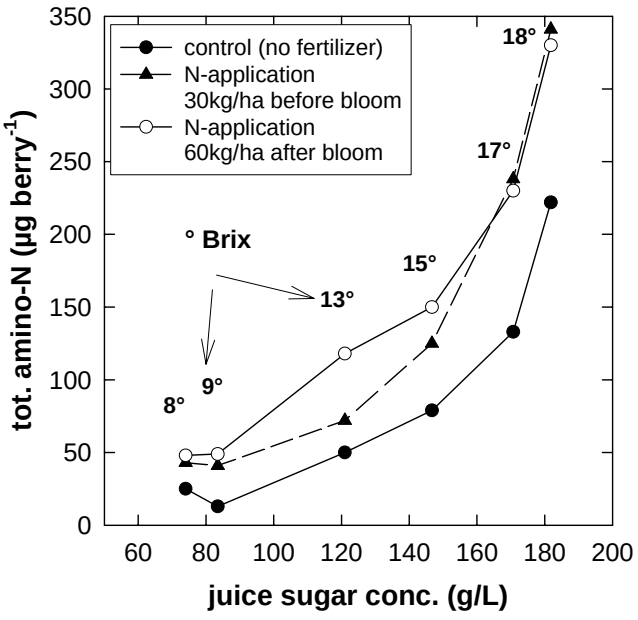

Fig. 1: Development of total amino-N content in Riesling berries during the ripening phase 1992. The data are from a trial on different N-fertilizer treatments. Numbers indicate degree Brix (adapted from Prior 1997).

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